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THE OLIVE INSECTS OF
CALIFORNIA

BY
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THE OLIVE INSECTS OF CALIFORNIA

BY E. O. ESSIG

INTRODUCTION

As compared with other trees in California, the olive is attacked by comparatively few insects and in many localities is almost entirely exempt from regularly destructive pests. The industry, however, is so large and conditions of insect work so varied that it seems advisable to collect all of the available information regarding the insects which infest this crop in one paper. The subject matter is discussed under the two general heads: I, the more important olive insects in California, and II, insects of minor importance to olive trees in California. There is also included at the end a brief discussion of some of the most important olive insects of other states and foreign countries which have not gained access to this state or, as in a few cases, do not attack the olive here.

The writer is specially indebted to Prof. C. W. Woodworth of the Division of Entomology and to Prof. Frederic T. Bioletti of the Division of Viticulture and Enology for many helpful suggestions and corrections.

I. THE MORE IMPORTANT OLIVE INSECTS IN CALIFORNIA

THE BLACK SCALE

Saissetia oleae (Bernard)

Figures 1 and 2

The black scale is the commonest and most troublesome insect pest of the olive in California, but there are many districts which have always been practically free from serious attacks. The young are liable to be killed by hot, dry weather and therefore the insect does not find the climatic conditions of the warmer valleys so favorable to its growth as those along the coast. However, it is gradually encroaching upon territory claimed a few years ago to be absolutely immune because of the hot, dry summers.

In most other states and especially in Europe, this insect is commonly known as the olive scale or olive cochineal and has received the specific name *oleae* from the olive which it commonly attacks. In California, it has always been called the black scale, either because of the dull black color of most of the females or because this insect is the one chiefly responsible for the growth of the black smut fungus over the leaves, stems and fruit of the infested plants. It has one

of the most characteristic markings to be found among the scale insects, consisting of a very plain elevated letter "H" upon the backs of both the young and old females. The male scales, which are much smaller than the females, are usually entirely wanting and when present appears as very thin, transparently white exuviae, from which the males, after undergoing transformation, emerge as tiny two-winged insects. This occurs when the females are about one-third or half



Fig. 1

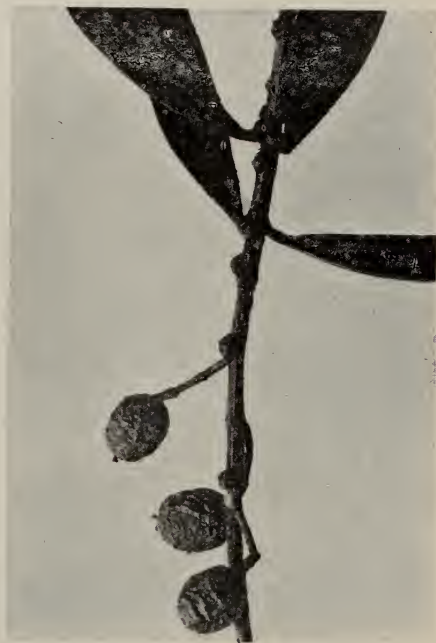


Fig. 2

Fig. 1.—The black scale, *Saissetia oleae* (Bern.). The young females as they appear on the olive leaves and twigs during the winter months. (Original).

Fig. 2.—Adult females of the black scale, *Saissetia oleae* (Bern.), on an olive twig. (Original.)

(Photos by Div. Sci. Illust., Univ. Calif.)

grown. After mating, the males die, and so it is that even when present, because of their small size, entirely different form, and short life, they are not generally known to the orchardists. The females, however, are always in evidence, and do the damage to the trees. They reach maturity in most localities during the months of June, July and August and lay from 100 to 3000 small oblong or oval whitish or amble-colored eggs which remain beneath the large, nearly hemispherical hollow body, the underside of which shrivels as the

eggs are laid till scarcely more than a thin shell remains. Upon hatching, the young, which have much endurance for such small creatures, crawl from beneath the bodies of the parents and seek suitable feeding places. The majority first settle on the undersides of the leaves along the midribs while the remainder seek the smaller twigs. Many, of course, perish during the winter, but by spring there are still great numbers remaining, and chiefly those which settled on the twigs. Those on the leaves also move to the twigs and remain there during the rest of their existence or until the old dead bodies fall off. The cold winter months are not conducive to growth, but with the coming of the warm spring days, development is rapid and the excrement, known as honeydew, begins to appear in quantities over the trees. This sweet excrement is the food of a black smut fungus, which, though an after-effect, is the most serious feature about this and many other scale insects. It is the prevention of the smut fungus that most often prompts the control of the black scale. The fungus serves as a good index to the time for spraying.

The black scale is a general feeder and attacks a large and ever-increasing number of plants, the known list for all countries including: almond, *Antidesma*, apple, apricot, mountain ash, aster, beech, buckthorn, camellia, California nutmeg, deodar cedar, *Cestrum*, chrysanthemum, citron, *Duranta*, eucalyptus, fig, fuchsia, geranium, grape, grapefruit, *Grevillea*, *Grewia*, groundsel tree, guava, English holly, mountain holly or Christmas berry, St. John's wort, jasmine, Irish juniper, laurel, lemon, black locust, honey locust, magnolia, mahogany, maple, *Maytenus*, *Melaleuca*, *Myoporum*, nightshade, oleander, olive, orange, trifoliate orange, orchids, palms, periwinkle, pigeon pea, pear, pepper tree, phlox, plum, pomegranate, poplar, privet, prune, rose rubber, sage, sumach, sycamore, tangerine, sago palm, strawberry tree, *Thespesia*, *Veronica*, and watermelon.

Considering the whole state, very little has been done towards the control of the black scale on olive trees. In a few of the large commercial plantings, particularly along the coast regions, some attention is given to the insect and control measures are employed whenever necessary. These control measures have been well worked out and have given very satisfactory results. In a few instances fumigation has been used in the citrus districts with marked success, but the cost as compared with spraying is so much greater that the latter practice is now almost universally followed where treatments are advantageous. The hardiness and resistance of the olive trees are remarkably great, making it possible to apply very strong sprays without injury to the fruit or foliage. Normally, the dormant sprays for deciduous

fruit trees are used, but it is advisable in most cases to reduce their strength about one-fourth to one-third, especially if the fruit is well matured on the trees. The materials used are chiefly oil emulsions, miscible oils and soap powders, although the rosin wash and the distillate-caustic soda-water mixture have also been used with success. The oil emulsions may be prepared at home or purchased from reliable manufacturers. Many growers, realizing the difficulty of securing proper materials for home preparations and the variability of the homemade mixtures, even under the best conditions, prefer to buy manufactured products, especially when only small quantities are needed. For those who desire a homemade product the following formula may be followed for a *crude oil* emulsion:¹

Crude oil (21° to 24° Baumé)	15 gallons
Liquid soap (or 20 lbs. hard fish oil soap)	3
Water	175

Place the required amount of water in the spray tank and add the liquid soap; agitate thoroughly and pour in the crude oil, continuing the agitation until the mixing is complete and no free oil remains on the surface and also during the application to the trees.

The *distillate-caustic soda-water mixture* is easily prepared as follows:

Distillate (28° Baumé)	7 gallons
Caustic soda (95%)	5 to 7 pounds
Water	to make 200 gallons

First dissolve the caustic soda in a small amount of water and add to the water in the spray tank; begin the agitation and slowly add the distillate, continuing the agitation during the application. This spray will also remove the lichens or moss from the trees.

The *rosin wash* is chiefly used for young and tender nursery stock, because it does not cause the injury often following the application of the previously named materials in such cases. The preparation is:

Rosin	10 pounds
Caustic soda (76% to 95%)	3 to 2½
Fish oil	1½
Water	to make 50 gallons

To a gallon of hot water in an iron kettle add the fish oil and the rosin and heat until the latter is softened; after first dissolving the caustic soda in a small quantity of water add it and stir the mixture thoroughly, after which pour in enough water to make fifty gallons of spray material.

¹ All of the spray formulae are reduced to meet the average needs for olive trees. They may be strengthened by one-fourth to meet extraordinary conditions.

The *miscible oils* cannot be satisfactorily prepared at home and should be purchased from a reliable manufacturer or dealer and used according to the directions that accompany them.

The oil emulsions, distillate-caustic soda-water mixture and the miscible oils often separate in the spray tank if the water contains much mineral matter and should be applied only with a good power

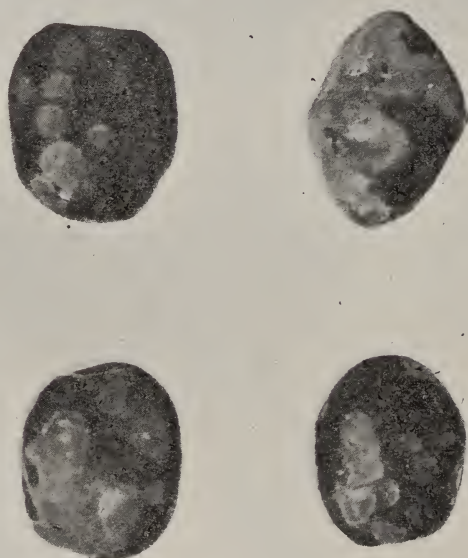


Fig. 3.—The ivy or oleander scale, *Aspidiotus hederae* (Vall.), and its work on the fruit of the olive. (Original.)

(Photo by Div. Sci. Illust., Univ. Calif.)

machine with a forceful agitator, which must be kept going during the entire process of application to avoid oil injury to the trees.

The *soap powders* are a revival in a somewhat different form of an old spraying material (soap) and in the present form are comparatively new in spraying work and are meeting with much favor because of their comparatively cheapness, ease of handling and efficiency. They are put up in barrels, and are ready to add directly to the water in the spray tank, dissolving readily in cold water with a small amount of stirring or agitation. The average dose is about one pound to every five gallons of water.

The best time to kill the scale is during the period just following hatching, usually in August and September, but fair results may be expected at any time from the middle of August to the first of January.

The proper quantity of material should be applied in the form of a rather coarse driving spray under a pressure of from 100 to 200 pounds. For the average-sized tree from five to seven gallons should be sufficient to thoroughly cover every portion adequately.

A sufficient number of scales to produce any noticeable amount of honeydew and cause a corresponding degree of smutting should be sufficient evidence to warrant spraying.

In spraying an orchard, it is important to keep the following in mind:

1. In case of doubt as to the strength of materials to use, spray a few trees to ascertain results before treating the entire orchard. Allow about two weeks to get the full results of the chemicals.

2. Never spray when the orchard is in need of water, as severe burning of fruit and foliage may result. Irrigate first or wait until after the first rain.

3. Do not spray during excessively hot weather or when hot winds are blowing.

4. Do not spray within several weeks before picking, if possible, as spotting of the fruit may result.

The control of the black scale by natural enemies has long been the subject of much experimental work without any very definite results. True, a number of predaceous and parasitic insects have been introduced to combat it, but their combined efforts are not sufficient to be a reliable factor in the control of the pest in the orchards.

The predaceous insects include the following:² the black ladybird beetle, *Rhizobius ventralis* Er., the ashy-gray ladybird beetle, *Olla abdominalis* (Say), *Lindorus lophanthæ* (Blaisd.), the steel-blue ladybird beetle, *Orcus chalybeus* (Boisd.) and *Axion plagiatus* Oliv. Of these, the first is the only one of importance. It was first introduced into the olive orchards of Santa Barbara County and has since been distributed generally throughout the state. The larvae and adults feed upon the black scale and in some districts become quite abundant. *Lindorus lophanthæ* (Blaisd.) is also quite widely distributed and preys partially upon the black scale. The others seem never to become very numerous or important.

² For a complete list, discussion and illustrations of predaceous and parasitic insects of the black scale, see Bul. 223, Calif. Agr. Exp. Station, July, 1911, by Prof. H. J. Quayle.

Among the parasitic insects, are the scutellista, *Scutellista cyanea* Mots., also known as the African fly, *Dilophogaster californicus* (How.), *Aphycus* sp. and the lecanium parasite, *Coccophagus lecanii* (Fitch). Of these the scutellista is by far the most important and at times becomes remarkably numerous, infesting nearly every egg-laying female of the scale. The larvae feed upon the eggs, but usually



Fig. 4.—The ivy or oleander scale, *Aspidiotus hederae* (Vall.). Adult females and young on an olive. (Original.)

leave enough to insure little or no diminution in the number of scales for the next year. Though not at all dependable, it is often relied upon by growers to do what can be accomplished with certainty with sprays, with the result that considerable loss is caused by the omission of control measures every year. The other parasites listed work much more spasmodically and little real investigation has ever been done to ascertain whether they do any good or not.

The state insectary is still continuing its endeavors to introduce parasites which will prey more effectively upon the immature stages of the black scale and it is hoped that every success will attend their efforts so as to reduce the expensive operation of spraying.

THE IVY OR OLEANDER SCALE

Aspidiotus hederae (Vallot)

Figures 3-6

In some parts of the San Joaquin and Sacramento valleys, this insect often becomes quite abundant on the leaves, and, in a few instances, on the fruit of the olive trees. In the latter case, it is



Fig. 5.—The ivy or oleander scale, *Aspidiotus hederae* (Vall.), on an olive leaf. (Original.)

(Photo by Div. Sci. Illust., Univ. Calif.)

specially annoying to the growers of ripe pickling olives. The infested fruits become spotted because the retarded development of the tissues around the scales leaves pits or depressions and the checking of the coloring in these places causes them to remain green while the rest of the fruit assumes the natural dark color (fig. 3). The insect gets its common names from the two plants most universally attacked, although in this state others are as commonly infested. It is what is called a true armored scale; that is, the female has over its small, nearly circular, yellow body a protection in the form of a thin gray or whitish circular scale about one-twelfth of an inch in diameter. The scale of the male is more elongated and somewhat smaller, the mature insect being small and winged as in the case of the black scale. In most cases, the scales are scattered over the surface of

the foliage in a very irregular way, while in others they are so thick as to overlap. On the fruit of the olive they occur in small colonies, each group often being composed of a single female and her progeny. The young are born alive and move freely until the first molt, when they lose their legs and must remain throughout the rest of their existence in one spot. Breeding continues almost throughout the entire year in many parts of the state, but it is much more rapid throughout the summer months.

As in the case of the black scale, the list of known food plants is very large and ever increasing, including, in all countries, the follow-

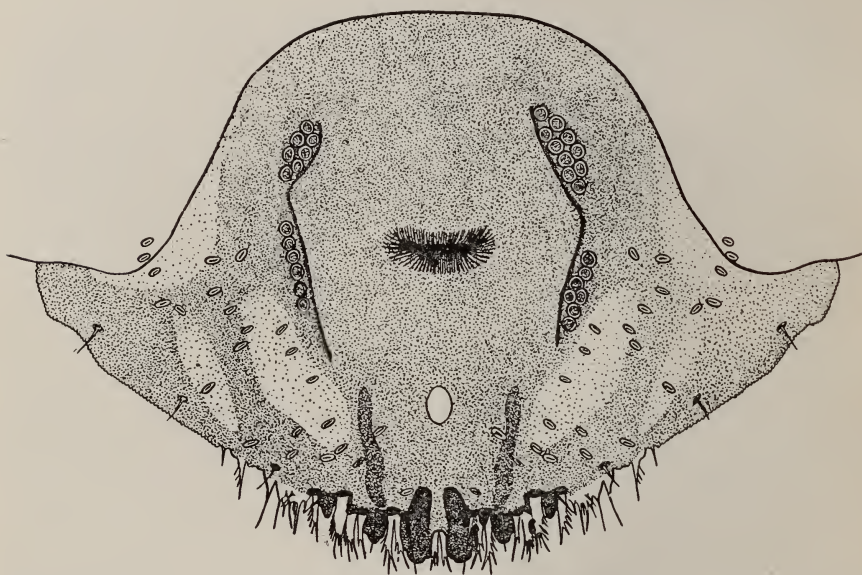


Fig. 6.—The ivy or oleander scale, *Aspidiotus hederae* (Vall.). Drawing of the pygidium of a female. Greatly enlarged. (Original.)

ing: Acacia, aloe or century plants, asparagus ferns, betel nut, boxwood, buckthorn, butcher's broom, California laurel or pepperwood, cactus, camellia, carob, *Carpodetus serratus*, cherry, citron, clover, currant, daphne, date palms, eucalyptus, fan palms, genista, grapefruit, grasses, *Hakea alliptica*, holly, English ivy, kentia palms, lemon, *Macrozamia*, madder, magnolia, manzanita, maple, mistletoe, Monterey pine, mulberry, *Myrsine retusa*, nightshade, oleander, olive, orange, orchids, oxalis, pepper tree, periwinkle, plum, pomegranate, *Prunus boldus*, holly oak, red-bud, redwood, rubber, sago palm, sumach, umbrella plant, umbrella tree, *Vitex littoralis*, *Vriesia splendens*, yew and yucca. From this list it will be seen that in-

festation may occur from a large number of sources outside the orchards.

The control of this insect is seldom attempted, for the actual loss does not, in most cases, justify the cost of treatment. Where control is desirable the oil emulsion and miscible oil sprays as recommended for the black scale should be used.

Natural enemies have never been considered of any consequence in the control of this scale, although there are both ladybird beetles and hymenopterous parasites that prey upon it in California as elsewhere.

THE BRANCH AND TWIG BORER

Polycaon confertus Leconte

Figure 7

The work of this beetle, which consists of small, round holes from one-eighth to one-fourth of an inch in diameter and usually less than an inch in length at the base of a bud or in the fork of a small branch, is familiar to many orchardists. Occasionally one also finds the beetle itself at work in the holes. It is small, brown and black and about half an inch long. The object of its work is probably to secure food, as no eggs are deposited or young reared in anything but dead wood, while the burrows in orchard trees are always made in perfectly healthy and living tissue. The injury is due to the breaking of the twigs at the holes, and the improper pruning of the trees which results. The young trees suffer most, though old trees are quite as commonly attacked. Plants known to be thus injured are: almond, apple, apricot, cherry, currant, fig, grape, lemon, olive, orange, peach, pear, plum and prune. As previously stated the insect normally breeds in dead wood, chiefly of the madrone, oak, and old grape canes where the larvae may often be found in great numbers.

The beetle occurs generally throughout the state, but has been most annoying in the Sacramento, San Joaquin, and Santa Clara Valleys and the central coast region. The attacks are spasmodic and of short duration and the damage done through a succession of years is really slight. Regular control measures have never been tested out because they are generally unnecessary. The elimination of the dead wood in which the insect breeds might be suggested as a preventive measure and in young orchards, where the attacks are severe, it might be advisable to go over the trees about once a week and kill the beetles in the burrows with a wire or knife blade.

THE OLIVE BARK-BEETLE

Luperisinus californicus Swaine

Figures 8 and 9

Though at present a comparatively unknown insect, this beetle may possibly become one that must be reckoned with in the future, if we are to judge by what little is now known regarding its work. A few adults were first taken by H. A. Weinland, then Horticultural Commissioner of San Diego County, in the Mission Valley near the

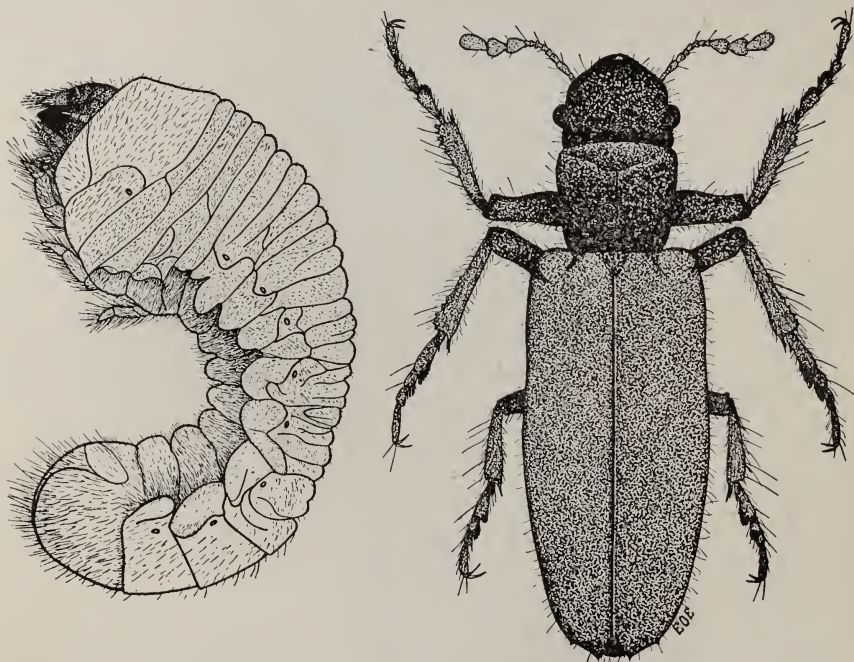


Fig. 7.—The branch and twig borer, *Polycaon confertus* Lec. Larva and adult. Enlarged. (Original.)

city of San Diego on May 17, 1915, and forwarded to the writer with the information that they were found injuring a living olive tree and might prove to be a serious pest. Other specimens followed from the same source on May 27 along with a piece of limb showing the work of the beetle and containing, within the burrows, a few cocoons of a hymenopterous parasite. On January 27, 1916, the present Horticultural Commissioner, Mr. H. M. Armitage, sent in a large number of the beetles as well as specimens of their work and a number of the parasites mounted on slides. The insect proved to be new to the university staff and they were forwarded to Mr. J. M. Swaine, Department of Agriculture, Dominion of Canada, a specialist in this

family of beetles, who pronounced it a new species and gave it the scientific name, *Luperisinus californicus*.³ For a common name the writer has proposed the olive bark-beetle, which seems to be sufficiently descriptive.



Fig. 8.—The olive bark-beetle, *Luperisinus californicus* Swaine. Work and exit holes made by the larvae and adults on an olive limb. (Original.)

(Photo by Div. Sci. Illust., Univ. Calif.)

The insect is a small, robust beetle about one-eighth of an inch long, black with whitish scales forming a more or less definite pattern on the back, as shown in the drawing (fig. 9). The legs and most of the antennae are reddish and the entire body is covered with small simple and plumose hairs of various sizes. In general shape and size,

³ *Canadian Entomologist*, vol. XLVIII, no. 6, pp. 190–192, June, 1916.

the adults resemble very closely the fruit-tree bark-beetle, *Eccoptogaster rugulosus* (Ratz.), a common pest to deciduous fruit trees in various parts of the state. The work also resembles that of this beetle and consists in the destruction of the cambium layer by numerous small burrows (fig. 8) which may entirely girdle the infested portions of the trees. The perfectly round entrance and exit

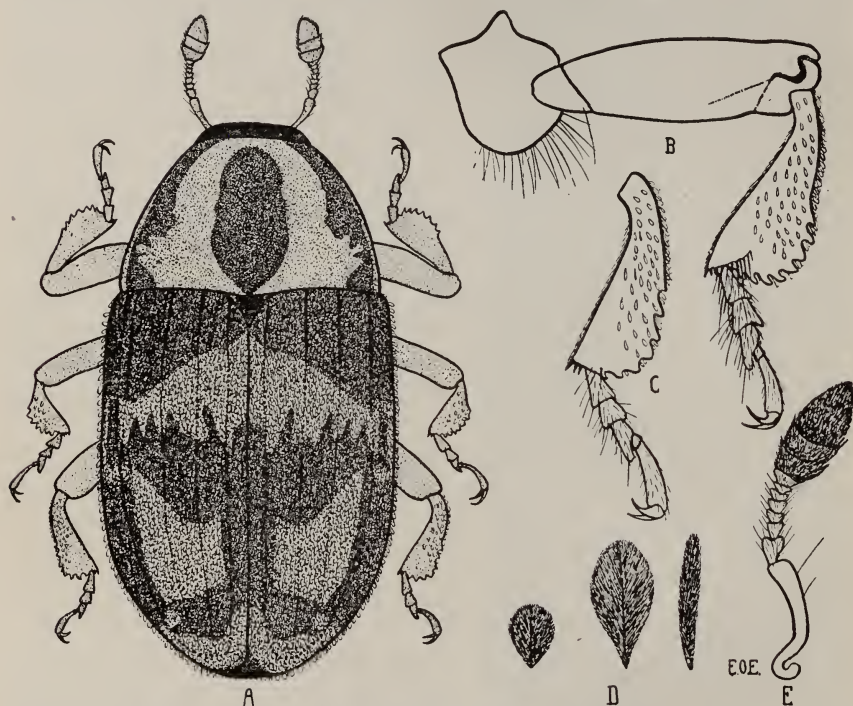


Fig. 9.—The olive bark-beetle, *Luperisinus californicus* Swaine. A, adult; B and C, leg and tarsi; D, plumose hairs from body; E, antenna. Enlarged. (Original.)

holes of the adults through the bark are the only distinct external evidences of the work, excepting the general unhealthy appearance of the infested trees. The insects apparently prefer sickly or dying trees and breed abundantly in them as well as in the dead prunings. However, like many of the orchard bark-beetles, they will not hesitate to attack perfectly vigorous and sound trees in close proximity to their breeding places, especially if an entrance may be gained through a sunburned or wounded spot.

The distribution of the species is not well known. Besides the infestation in San Diego County, already referred to, adults were taken at Camp Greely, Fresno County, as early as 1909 by Mr. Ralph Hopping,⁴ but no host plants were recorded, the specimens having

⁴ *Canadian Entomologist*, vol. XLVIII, no. 6, p. 192, June, 1916.

been collected in sweepings in the chaparral belt at an elevation of 3000 feet. So far there have been no reports of its attacking olive trees in Fresno County. On July 9, 1916, the writer received a small piece of olive bark from a grower at Bakersfield, Kern County, showing small exit holes exactly like those made by the insect in question, with the statement that the insect causing the injury had badly attacked the young olive trees with the result that one was already dying. The possibilities of its being the same thing are very strong, though no opportunity has been afforded to make a personal investigation.

As in the case of other orchard bark-beetles, the first essential in avoiding attacks is to maintain a healthy condition of all the trees and to prevent sunburn and injuries which lessen their vitality and furnish the proper conditions for the entrance of the beetles. The immediate burning of all prunings is also important, to eliminate possible breeding places around the orchards. After an orchard has become infested, the only effective step is to cut out and burn all infested limbs or trees as soon as discovered, to avoid spreading and continued attacks.

The small hymenopterous parasite⁵ which attacks the immature stages within the burrows is not likely to be of much consequence in controlling the beetle.

II. INSECTS OF MINOR IMPORTANCE TO OLIVE TREES IN CALIFORNIA

Of the following insects, it is not likely that any will prove of real economic importance, but they are included because they are sometimes found infesting the olive trees and excite the suspicion of the orchardists.

1. The citrus thrips, *Scirtothrips citri* (Moulton). Taken in the flowers of olive trees in the San Joaquin Valley.⁶

2. The bean thrips, *Heliothrips fasciatus* Pergande. Reported as seriously infesting the fruit of olives in San Joaquin County in 1915.⁷

3. The net-winged cicada, *Platypedia areolata* Uhler. Sometimes punctures the small limbs of the olive to insert its eggs. The punctures cause the twigs to become distorted or to break. The distribution is general throughout the state.

⁵ The parasite has been determined by Mr. Rohwer as *Ecphyllus*, probably *schwarzi* Rohwer, through the kindness of Mr. Harry S. Smith, superintendent of the State Insectary.

⁶ Jones, P. R. & Horton, J. R., Bull. no. 99, pt. 1, p. 3, Bur. Ent., U. S. Dept. Agr., 1911.

⁷ Smith, H. S., Mthly. Bull. Cal. Hort. Com., vol. IV, p. 574, 1915.

4. The mountain-ash louse, *Prociphilus fraxini-dipetalae* (Essig) (fig. 10). This species rarely attacks the olive, having been taken by the writer on the tender sprouts at Berkeley, 1914, and on the leaves at Corning, the same year, by Chas. B. Weeks, Horticultural Commissioner.

5. The red scale, *Chrysomphalus aurantii* (Mask.). A citrus pest reported on olive in the southern part of the state by Prof. H. J. Quayle.⁸ It was recently received from Roy K. Bishop, Horticultural Commissioner, who took it on olives in Orange County. The leaves were thickly covered.

6. The purple scale, *Lepidosaphes beckii* (Newm.). Also a citrus pest reported on olives in southern California by Prof. H. J. Quayle.⁹

7. The greedy scale, *Aspidiotus camelliae* Sign. (figs. 11 and 12). Very common on the bark of the branches, especially of old suckers. It may be easily mistaken for the ivy or oleander scale, the color being much the same, but the outside shell is more robust, nearly conical in shape and with the small exuvia or nipple at one side rather than at the middle. The characters of the anal plate, as shown under the microscope (fig. 12) at once separate it from the ivy or oleander scale (fig. 6). Though often abundant, it does not seem to hurt the infested portions in any noticeable way.

8. The omnivorous looper, *Sabulodes caberata* Guen. The caterpillars of this moth occasionally feed upon the leaves of the olive trees at Berkeley.

9. The larvae of a moth (Pyralid?) have been taken a number of times from the knots on the olive limbs produced by the bacteria, *Bacterium savastanoi* Smith, by Prof. W. T. Horne and Prof. Elmore Chase at Fair Oaks. The soft spongy tissues as well as the



Fig. 10.—Apterous females and young of the mountain ash louse, *Prociphilus fraxini-dipetalae* (Essig), on olive. (Original.)

⁸ Bull. 222, Cal. Agr. Exp. Sta., p. 106, 1911.

⁹ Bull. 226, Cal. Agr. Exp. Sta., p. 325, 1912.

harder portions of the knots are thoroughly perforated with the burrows (fig. 13) made by the caterpillars. It does not appear to attack any other parts of the trees. The caterpillars are whitish and about one inch long. They are quite abundant, but so far no adults have been reared to determine the species.



Fig. 11.—The greedy scale, *Aspidiotus camelliae* Sign., on old olive suckers. The smut fungus which partially conceals the scales is from black scale on the same tree. (Original.)

(Photo by Div. Sci. Illust., Univ. Calif.)

SOME OF THE PRINCIPAL INSECTS ATTACKING THE OLIVE TREES IN OTHER STATES AND FOREIGN COUNTRIES

There are but few olives grown in other states of this country, consequently the list of pests on them is very short. In a number of foreign countries, however, and particularly in the Mediterranean region, where the olive has been growing for ages, the number of recorded pests is quite large. Among the many there are but few serious enough to warrant control measures. In the following list

the most important ones as well as a number of lesser importance which are most often found in published economic literature, are included so as to give some idea of the difficulties of growing olives in other districts, as well as to reflect the benefit derived from excluding these by state and national quarantine.



Fig. 12.—Drawing of the pygidium of the greedy scale, *Aspidiotus camelliae* Sign. Greatly enlarged. (Original.)

Palestine, and South Africa and at times is a serious pest.

2. The cicada, *Tibicen cinctifer* (Uhler). The egg punctures weaken the small twigs and branches of young olive trees in the Salt River Valley, Arizona.¹⁰

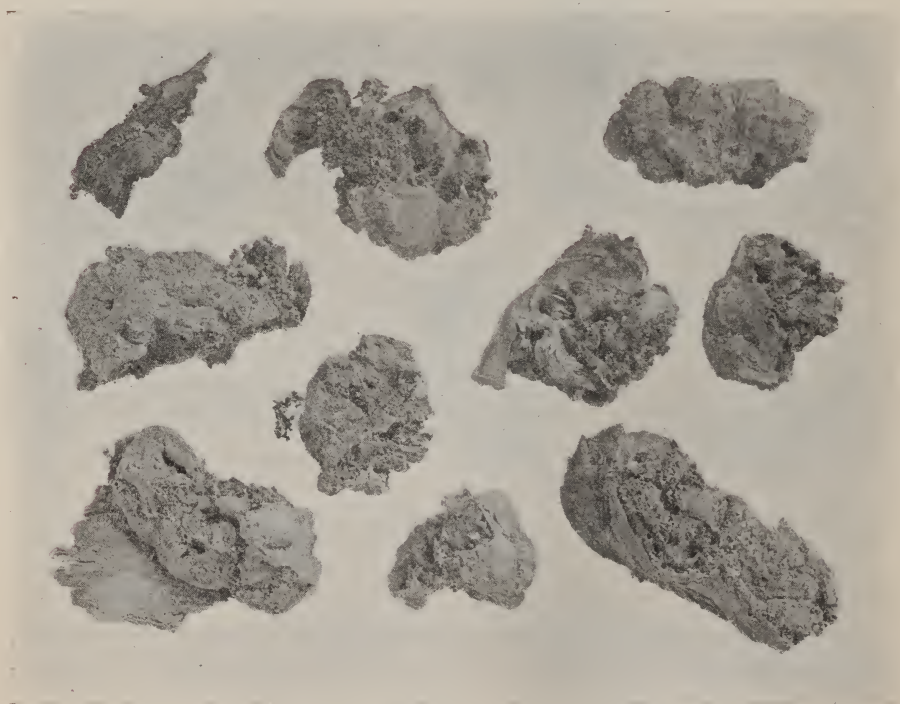


Fig. 13.—Work of a caterpillar on the olive knot at Fair Oaks. (Original.)

(Photo by Div. Sci. Illust., Univ. Calif.)

¹⁰ Morrill, Dr. A. W., 7th Ann. Rept. Com. Agric. and Hort., p. 34, 1915, *Cicada*.

3. The olive psylla, *Euphyllura olivina* (Costa) (fig. 15). This insect infests the young shoots, buds and flowers, causing the latter to drop and prevents the setting of much of the young fruit. The young psyllids are covered with a white cottony material which entirely hides them from view. It occurs throughout southern

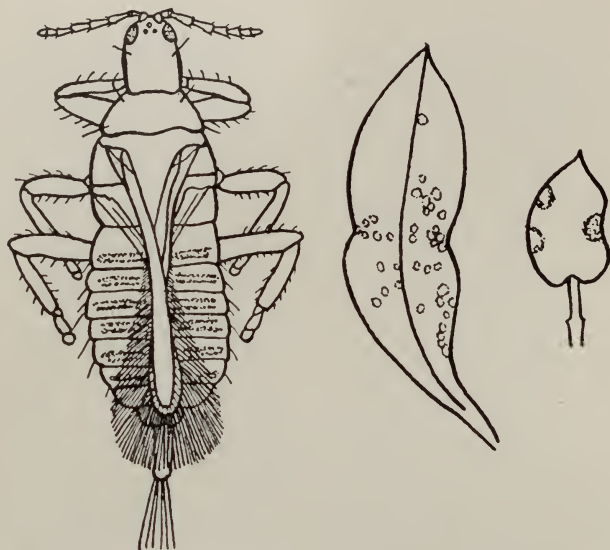


Fig. 14.—The olive thrips, *Phloeothrips oleae* (Costa). Adult female and work of the insect on leaf and fruit of the olive. (Redrawn from Del Guercio.)

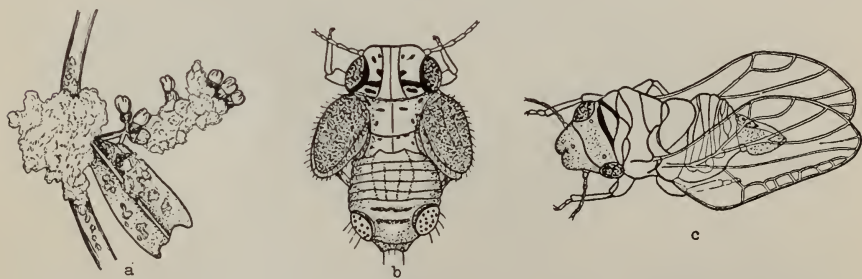


Fig. 15.—The olive psylla, *Euphyllura olivina* (Costa). a, colony of young on twig and flowers; b, nymph; c, adult. (Redrawn from Coutance and Del Guercio.)

Europe and in Palestine and is a pest of minor importance except in rare instances.

4. The scale, *Pollinia pollini* (Costa). A soft scale attacking the smaller branches of the olive trees in southern Europe. It was once taken on a few olive trees at Pasadena, California, which were imported from Italy in 1893. Alexander Craw at once promptly de-

stroyed the infested trees and apparently exterminated the insect.¹¹ Where found it is a pest of little importance.

5. The scale, *Filippia oleae* (Costa). A soft scale infesting the olive leaves in southern Europe, but not nearly so serious as the black scale, *Saissetia oleae* (Bern.) in the same localities, because it produces little honeydew and causes practically no smutting.

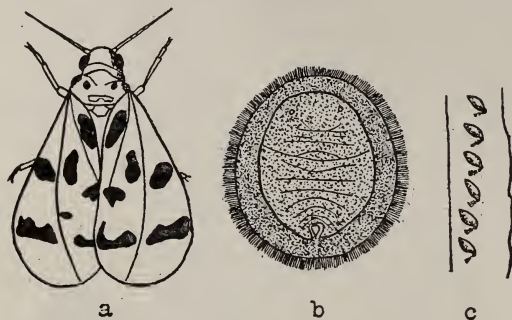


Fig. 16.—The olive white fly, *Aleyrodes olivinus* Silvestri. a, adult; b, nymph; c, row of eggs. (Redrawn from Silvestri.)



Fig. 17

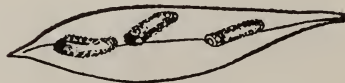
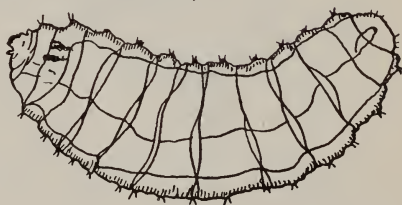


Fig. 18

Fig. 17.—Adult of the bark-beetle, *Hylesinus oleiperda* (Fab.). (Redrawn from Barbey.)

Fig. 18.—The olive leaf-miner, *Perrisia oleae* Angelini. Larva and the mines on an olive leaf. (Redrawn from Del Guercio.)

6. The terrapin scale, *Lecanium nigrofasciatum* Pergrande, was reported by Pergrande as occurring on olive in Florida.¹²

7. *Leucaspis riccae* (Targ.). A scale insect commonly attacking olive trees in southern Europe and northern Africa, but of little consequence as a pest.

8. The rufous scale, *Selenaspidis articulatus* (Morgan). A scale occurring in southern Africa, West Indies and at Key West, Florida.

¹¹ 4th Bien. Rept. Cal. Bd. Hort., p. 438, 1894, and 5th Bien. Rept. Cal. Bd. Hort., p. 43, 1916.

¹² Bull. 18, N.S., U. S. Dept. Agr., Bur. Ent., p. 26, 1898.

It attacks citrus and olive trees and is of some importance as pest to the former.

9. The masked scale, *Chrysomphalus personatus* (Comst.). Reported by Dr. T. D. A. Cockerell as severely attacking olive trees at Kingston, Jamaica.¹³

10. The black araucaria scale, *Chrysomphalus rossi* (Mask.). There are many reports to the effect that this scale is a serious olive pest of different parts of Australia.¹⁴ It occurs in California on *Araucaria* spp., but has shown no tendency to attack the olive here.

11. The laurel scale, *Aonidia lauri* (Bouché), is reported as seriously attacking olive trees in Chili.¹⁵

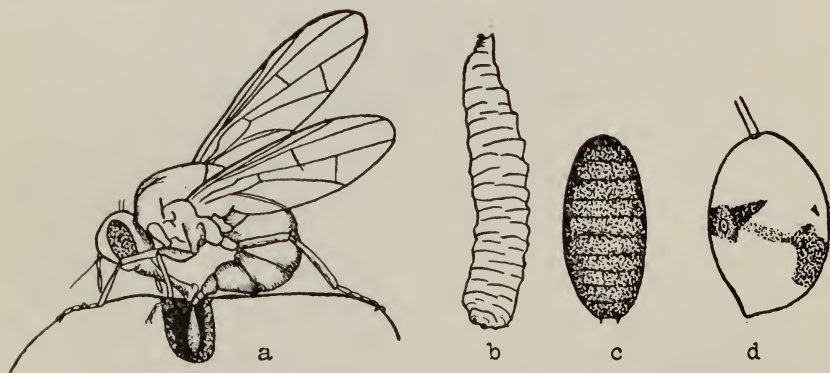


Fig. 19.—The olive fly, *Dacus oleae* Rossi. a, adult laying eggs in the fruit of the olive; b, maggot; c, puparium; d, olive showing egg puncture, work and exit hole of the maggot. (Redrawn from Chapelle, Ruby and Martelli.)

12. Glover's scale, *Lepidosaphes gloverii* (Pack.). Also known as the long scale. Attacks the olive in southern France and northern Africa (Tunis). It occurs in San Diego County, where it sparingly attacks citrus trees, but has never been recorded on olive in this state.

13. The scale, *Parlatoria calianthina* Berl. e Leon. Infests the olive in southern Europe. Taken on imported olive trees from Greece in quarantine at San Francisco by inspectors in 1915.¹⁶

14. The olive white fly, *Aleyrodes olivinus* Silvestri (fig. 16). The nymphs of this insect occur on the leaves of olive trees in central and southern Italy as well as in Spain, Tunis, and Smyrna. It is not a pest of any serious consequence.

15. The bark-beetle, *Hylesinus oleiperda* (Fab.) (fig. 17). This

¹³ *Insect Life*, vol. V, p. 121, Nov., 1892.

¹⁴ French, C., *Handb. Destr. Ins. Victoria*, pt. II, p. 50, 1893, and Despeissis, A., *Handb. Hort. and Vit.*, 2nd ed., p. 576, 1903.

¹⁵ Philippi, Dr. R. A., *Insect Life*, vol. I, p. 154, Nov., 1888.

¹⁶ Maskew, Frederick, *Mthly. Bul. Calif. Hort. Com.*, vol. V, p. 75, 1916.

beetle causes considerable damage in southern Europe by burrowing into the older portions and the limbs of the olive trees. It is, however, primarily a pest of unhealthy or injured trees.

16. *Phloeotribus scarabaeoides* Bern. (Syn. *P. oleae* Fabr.). Another bark-beetle which makes galleries in the branches and cuts off the small twigs by its burrows. It is a serious pest in Italy. This and the preceding beetle are closely related to the olive bark-beetle recently discovered in California and discussed in this paper.



Fig. 20.—The olive tineia, *Prays oleellus* (Fab.). *a*, caterpillar; *b*, adult; *c*, work of caterpillars in seeds; *d*, exit hole of the caterpillar in a fruit; *e*, webs and work of caterpillars on buds and blossoms; *f* and *g*, work of the caterpillars on the leaves of the olive. (Redrawn from Chapelle, Ruby, and Del Guercio.)

17. The olive weevil, *Rhynchites ruber* Fairm. The adults feed upon the tender leaves and tips of the young shoots and puncture the young fruit. The larvae live in the seeds. It does serious damage at times to the olive crop in Italy.

18. The olive leaf-miner, *Perrisia oleae* Angelini (fig. 18). A small cecidomyiid fly the maggots of which mine the leaves of the olive trees in Italy. It is of little economic importance as a pest.

19. The olive fly, *Dacus oleae* Rossi (fig. 19). This is undoubtedly the most serious pest of the olive to be found anywhere and it is very fortunate that it has never gained access to this state. It occurs in the olive-growing sections of southern Europe, Asiatic Turkey, Palestine and northern and southern Africa. The fly punctures the fruit in which it deposits its eggs and within which the larvae

or maggots live until mature. The work of the maggots results in the premature dropping of the fruit and a diminution in the yield of oil. Considerable money is spent annually by the olive growers in the control of this pest.

20. The olive tine, *Prays oleellus* (Fab.) (fig. 20). This small moth is quite a serious pest in southern Europe and of less importance in Palestine. The caterpillars feed upon the buds, blossoms, and in the seeds of the fruit causing much loss in many cases. It is probably second in importance to the olive fly.

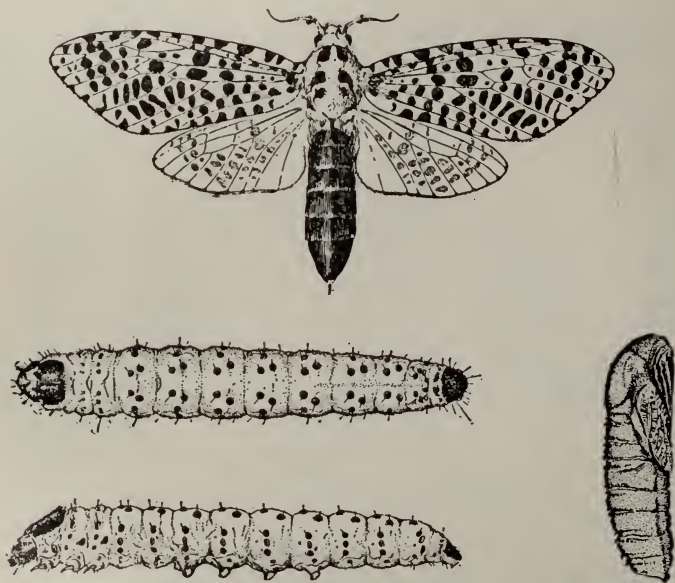


Fig. 21.—The leopard moth, *Zeuzera pyrina* (Linn.). Adult female, caterpillars and chrysalis. Natural size. (After Britton.)

21. The leopard moth, *Zeuzera pyrina* (Linn.) (fig. 21). The caterpillars of this moth bore large galleries into the wood of perfectly sound and healthy trees and do considerable damage to olive trees in southern Europe, especially in Italy. It is reported as the most serious olive pest in Palestine. It also occurs in northern and southern Africa and in Korea, Japan, and along the Atlantic seaboard from Massachusetts to the southern part of New Jersey. The insect is a very destructive pest to a large number of shade and forest trees, as well as to such cultivated fruits as apple, cherry, currant, pear, plum, and walnut. It is an insect that we might well take extra precautions to keep out of California by quarantine or other measures.¹⁷

¹⁷ See Farmers' Bull. 708, U. S. Dept. Agr., Feb., 1916, Howard and Chittenden, and Bull. 169, Conn. Agr. Exp. Sta., Nov., 1911, by Britton and Cromie.